Abstract

This work concerns development, evaluation and performance of quality assessment methods for volume-selection methods in ^{31}P and ^{1}H MR spectroscopy (MRS). The work also contains different aspects of the measurement procedure for ^{1}H MR spectroscopic imaging (MRSI) with application on the human brain, image reconstruction of the MRSI images and evaluation methods for lateralization of temporal lobe epilepsy (TLE).

The first two papers present two-compartment phantoms and evaluation methods for quality assessment of ^{31}P MRS in small-bore MR systems. The two methods complement each other. In paper I, a phantom with an inner cube inside a sphere, was used in a multi-centre study to adapt and evaluate a quality assessment protocol proposed by the "EEC concerted action". The protocol is based on comparisons between results of measurements without and with volume selection using volumes-of-interest, VOIs, of various sizes. The evaluated parameters provide useful information of the performance of volume-selective MRS at the MR system. The protocol is, however, unspecific regarding the appearance of the excited VOI and contamination from different gradient directions. In paper II, a phantom, consisted of two compartments divided by a very thin wall, and an evaluation method for VOI profile measurements was presented and evaluated. The principle of the phantom and the evaluation method were useful for measurements of the VOI profile and position of the VOI in specific gradient directions.

The last three papers concern ^{1}H MRS and MRSI of MR whole-body systems. In paper III, different factors that may degrade or complicate the measurement procedure for MRSI were evaluated. A high-resolution phantom, with a movable signal source in a sphere, was adapted to ^{1}H MRS. The VOI profile measurements gave detailed information regarding the shape and position of the VOI, and the degree of contamination from unwanted signal. Susceptibility sensitive images were found useful to identify regions where susceptibility differences may degrade the MRSI results. Phantom studies visualised the effect of susceptibility differences and object motion on MRSI. Motion artefacts may not be visually distinguished in *in vivo* MRSI images, but will give considerable false contributions to the data.

In paper IV, two interpolation methods for reconstruction MRSI images were compared: Fourier interpolation (FoI) and Cubic spline interpolation (CspI). Measurements and computer simulations showed that FoI correctly visualizes the information inherent in the data set, while the results were dependent on the position of the object relative the original matrix using CspI. FoI does not remove the effect of the limited sampling of k-space. Application of weighting functions (filters) may be used to suppress the side lobes of the spatial response function and improve the image representation of the data.

In paper V, ^{1}H MRSI was performed on healthy volunteers and patients with temporal lobe epilepsy (TLE). Metabolite concentration images were used for lateralization of TLE, where the signal intensity in the two hemispheres was compared. Two methods were used, visual analysis of the images, and measurements of the signal intensity of regions-of-interest (ROIs) at different locations. Visual analysis can, with high accuracy, be used for lateralization in routine examinations. ROI analysis gives quantitative information about the degree of signal loss and the spatial distribution.

Keywords: magnetic resonance; MRS; MRSI; CSI; ^{31}P; ^{1}H; temporal lobe epilepsy; phantom

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